

COMSTOCK MEMORIAL LIBRARY

# A PAPER

ON THE

NOMENCLATURE OF THE PARTS OF THE HEAD

OF

# I N S E C T S,

(READ BEFORE THE ENTOMOLOGICAL SOCIETY OF LONDON, DECEMBER 2, 1833,  
AND PUBLISHED, WITH EXPLANATORY PLATES, IN THE  
ENTOMOLOGICAL MAGAZINE).

BY

EDWARD NEWMAN, F.L.S.

---

"I find it impossible to give, according to the present state of the science in England, any satisfactory description of insects without making some previous observations on their anatomical nomenclature."—MACLEAY.

"Ce que personne n'avait encore tenté j'ai osé l'entreprendre." - SAVIGNY.

"Dans ce travail je n'ai d'autre mérite que d'avoir généralisé." MARCEL DE SERRES.

---

LONDON :

PRINTED FOR THE AUTHOR, BY R. CLAY,  
BREAD-STREET-HILL, CHEAPSIDE.

1834.

QL494  
N53

For plate illustrating this  
paper see Ent. Mag. Vol II frontisp.

## A PAPER,

&c.

---

IN addressing the following observations to the Entomological Society of London, it seems needful to remark that they form part of an essay, now in the course of publication in the Entomological Magazine, under the title of "Osteology, or External Anatomy of Insects." In all probability very few of the members of this Society have even heard of that essay, or are in any way acquainted with its nature and objects; permit me, then, to premise that it has in view the establishment of a uniform nomenclature for all the parts observable in Hexapod Insects. One portion only of the essay has been published; in which, adopting an idea previously broached, I have attempted to show that all Tetrapterous Hexapods are composed of thirteen segments or rings; to these rings I have proposed the following names:—1. *Caput*; 2. *Prothorax*; 3. *Mesothorax*; 4. *Metathorax*; 5. *Propodeon*; 6. *Podeon*; 7. *Metapodeon*; 8. *Octoon*; 9. *Ennaton*; 10. *Decaton*; 11. *Protelum*; 12. *Paratelum*; 13. *Telum*. I have further shewn that the legs are attached thus,—the first pair, which I propose calling *Propedes*, to the *Prothorax*; the second pair, *Mesopedes*, to the *Mesothorax*; the third pair, *Metapedes*, to the *Metathorax*: and that the wings are attached thus,—the first pair, to the *Mesothorax*, to be called *Proalæ*; the second pair, to the *Metathorax*, to be called *Metalæ*. As far as my knowledge extends, no technical term had been previously applied to nineteen out of these twenty-three parts; whilst four, the *Caput*, *Prothorax*, *Mesothorax*, and *Metathorax*, had received, some years before, the names now retained. I propose, further, that the prefixes, *pro*, *meso*, and *meta*, be applied to the individual articulations of each pair of legs, these never having, to my knowledge, received technical appellations.

The present paper, though but a portion of a larger work, and relating only to one segment out of the thirteen, is in itself complete, inasmuch as it contains all that will be said concerning the head. Permit me, further, to premise that the proposed nomenclature and descriptions have reference solely to the hexapods; the organs described appear throughout the annulate kingdom of animals, but under widely different circumstances and forms.

I beg to thank the Society for permitting this paper to be read, after I had reserved the right of publication in another channel; a degree of liberality which, if persevered in, will ensure an overflow of communications.

---

It appears scarcely to admit of a doubt, that the head of an insect is composed of four distinct portions. That the portions of the head are merely sections, appears to me consistent with the general harmony of Nature.<sup>a</sup> The second segment in the locust tribes, and the third segment in the bee tribes, present to the inquirer a quadruple division by far more manifest. You will however remark, and it is of no mean importance, that, while the portions of the second, third, and following segments, are united by suture, those of the head have a freely moveable articulation. That the portions of the head are segments, is argued from the circumstance, that those organs which in one group are employed for manducation, in another serve solely for progression. When this is the case, the organs thus modified differ in no material characters from those of the second, third, and fourth segments. Consequently, it is said, that by their increase of importance to that of true organs of locomotion, they also raise the portions which bear them to an importance equal to that of those portions which uniformly bear such organs.

These changes in the uses to which organs are applied we frequently detect in progress in intervening groups. They afford the most obvious distinguishing characters. A man is termed a biped; a horse, a quadruped; and not incorrectly: yet the number of limbs in each is the same. In man, the first pair of limbs is essential to feeding; in

<sup>a</sup> The segments of the head, which are sometimes three, but typically four, are therefore of course only to be considered as secondary.—*MacLeay.*

the horse, these are purely organs of locomotion, and differ in no respect from the other organs destined to the same end; but in many animals we find them applied with perfect ease to either purpose. The adaptation of the same organs to different purposes in the superior animals is obvious; consequently, in the inferior, fairly to be inferred. Conclusions of this kind have been stigmatized as theoretical. Be it so: theory may be sound as well as unsound. When theory is a compound, of which facts are the ingredients, it is sound. In the present instance, facts are the ingredients. Whether the four portions of the head be primary or secondary parts,—in other words, whether they be segments or sections of segments, seems to hinge on another question; *viz.* whether a single segment can bear four feet; for it seems scarcely to admit of a doubt, that, in some annulate animals, the part which is analogous to the head of tetrapterous hexapods has four organs of progressive motion employed as feet. This circumstance appears to me by no means more remarkable, than that the third and fourth segment should each bear four organs of progressive motion, two of them adapted to walking, and two to flight. On these grounds I have considered the four parts of the head as so many sections of a segment, and consequently equivalent to the sections of succeeding segments. To give them the same names, however, while a doubt remains, would be objectionable; more especially, as a nomenclature sufficiently definitive has been long established, although in its application confused and various. The parts of the head are the skull, the lips, the feeler-jaws, and the mandibles. These are the four sections of a segment. To simplify and conform to received ideas, the three last must be treated of as the *mouth*, of which, in tetrapterous hexapods, they constitute the component parts.

The skull of insects is compact, solid, and osseous. It has a large opening in front, in which is situated the mouth; another behind, through which pass the *œsophagus*, spinal cord, blood-vessels, muscles of connexion with the *prothorax*, &c.; and two smaller ones, generally in front, above that of the mouth, in which are placed the antennæ. There are two compound eyes, one on each side, so closely soldered into the skull, that, in case of fracture, the separation does not take place at the suture. Desvoidy well observed, that the eyes

form the lateral regions of the skull. Besides these compound eyes, insects have generally two or three *ocelli*, or simple eyes. These, like the true eyes, are firmly fixed in the skull, and are alike incapable of being separated from it without fracture. The simple eyes are situated usually on the crown of the head; their number is generally, in *Lepidoptera*, two; in *Diptera*, three; in *Hymenoptera*, three; in *Coleoptera*, none;<sup>b</sup> in *Orthoptera*, three; in *Hemiptera*, two. With the exception of the compound and simple eyes, the skull is a single, continuous, and undivided piece. Entomologists have endeavoured to assign names to the different regions of the skull, but have hitherto been unable to establish them. It cannot be too frequently or too emphatically repeated, that names of parts having unfixed limits are objectionable, as leading to confusion. An author might establish his nomenclature from a single species, provided inquiry was directed to that species alone. The anatomy of a beetle's or locust's skull gives us scarcely any idea of that of a butterfly's. A nomenclature well adapted to the skull of a cockchafer would be useless for that of a dragon-fly. Fabricius describes no parts but the forehead, *clypeus*, throat, and simple and compound eyes. Latreille, Burmeister, and many others, recapitulate the labours of preceding writers. Desvoidy is original, precise, and clear, but his nomenclature is adapted solely to *Diptera*.<sup>c</sup>

<sup>b</sup> In the fourth number of Germar and Zincken Sommer's Magazine, it is affirmed, that they are discoverable in Gravenhorst's genus *Omalium*, but not in the kindred genera *Micropeplus* and *Anthophagus*. Upon examining the former genus, I find, that although *Omalium planum* and affinities, *O. Striatulum*, and some others, appear not to have them, yet with the aid of a good magnifier they may be discovered in most species of that genus, as likewise in *Evaesthetus*. I find them also very conspicuous in *A. Caraboides* and other *Anthophagi*, but some species appear to want them.—Kirby.

On a prétendu que les *Anthophagus*, les *Omalium* et les *Paussus* avaient de ces yeux simples; mais j'avoue que je n'ai jamais pu les apercevoir. — Straus-Dürckheim.

<sup>c</sup> La tête offre six régions principales : le front; la face; la région inférieure; la région postérieure : les yeux forment les deux régions latérales. 1. Le front (*frons*) ou la région frontale, s'étend de la partie postérieure de la tête, à la base des antennes, et d'un œil à l'autre œil. Il se divise en trois parties. La partie la plus postérieure, et celle qui ordinairement a le moins d'étendue est située derrière les stemmata, et porte le nom de vertex (*vertex*). La partie stemmatique, ou les stemmata (*stemmata*), placée entre le vertex et le vrai front, consiste en un petite pièce ordinairement demi-circulaire, où les yeux lisses sont implantés. Le front, le vrai front (*frons*) s'étend d'un œil à l'autre et de la région

Straus-Dürckheim's description of the skull of a cockchafer is beautifully simple; and the only one yet pub-

stemmatique à la base des antennes. Il offre sur son milieu deux pièces ordinairement adossées et colorées assez régulières : ce sont les frontaux (*frontalia*). A la partie antérieure du front, dans un triangle plus ou moins prononcé, vers l'origine des frontaux, on remarque deux pièces plus ou moins développées, et qui parviennent même à separer les frontaux, et a s'intercaler entre eux dans toute leur longueur : ce sont les inter-frontaux (*interfrontalia*). Les parties latérales du front sont formées, ainsi que je le dirai, par le prolongement des optiques. La région frontale est ordinairement plus développée sur les femelles que sur les mâles. 2. La face (*facies*) est la région qui s'étend plus ou moins verticalement de la base des antennes à l'épistome et transversalement d'un œil à l'autre œil; c'est à tort que les entomologistes Allemands la nomment hypostome (*hypostoma*). Cette région se compose de diverses parties distinctes qui meritent d'être spécialement caractérisées. La portion médiane offre deux fossettes (*foveæ*) verticales ou obliques, qui servent de support aux antennes dans le repos : ces fossettes, faites de deux pièces souvent très distinctes, forment quelquefois une cloison par l'adossement de leur côtés internes; alors elles émettent une petite crête, plus ou moins aiguë à leur point de jonction. Le long du côté externe de chaque fossette s'étend une pièce, plus ou moins développée, plus ou moins ciliées, qui part de la base des antennes, longe le bord de la face, prend un peu plus de volume vers son angle antérieur, et porte un gros cil avec une sorte de moustache, due à d'autres cils moins forts. Ces deux pièces qui portent le nom de faciaux (*facialia*) sont souvent ciliées le long des bords du péristome. Les médianes (*mediana*) sont des pièces ordinairement triangulaires, souvent un peu colorées, et susceptibles d'acquérir un certain développement, qu'on remarque entre les faciaux et les pièces du pourtour de l'œil un peu au-dessus des pièces latérales du péristome ; ils ne montent jamais jusqu'à la base des antennes. Je nomme optiques (*optica*) les pièces plus ou moins bombées, qui entourent l'œil sur la face, montent jusqu'à la base des antennes, s'étendent jusqu'au vertex, et jusque derrière l'œil. Souvent ils forment vers les antennes la crête aiguë ou l'angle qui sépare le front d'avec la face. Ils sont ordinairement piligères surtout à la région frontale ; plusieurs observations tendent à me faire croire que, vers l'angle frontal, ces pièces optiques sont manifestement séparées. Si ce fait vient à se confirmer, on aura les optiques frontaux (*optica frontis*) et les optiques de la face (*optica faciei*). Ces optiques correspondent à une portion des joues (*genæ*) des auteurs. 3. La région inférieure située entre la face et la région postérieure, offre un cavité où la base de la trompe et la plupart de ses muscles prennent leur attache, et où la trompe se retirée ordinairement pendant le repos. Cette cavité que je nomme péristome (*peristoma*) est formée de deux pièces latérales qui se souduent en avant et en arrière. J'appelle épistome (*epistoma*) son bord antérieur, qui en haut se soude avec les fossettes et se développe souvent en bec. Cet épistome affecte diverses formes qu'il importe beaucoup de remarquer : sur quelques genres, il est manifestement formée par deux pièces. Les faciaux longent latéralement les pièces du péristome et souvent ils y sont ciliés. Les latéraux (*lateralia*) sont de deux pièces ordinairement assez développées et faciles à distinguer, que l'on voit sur les côtés inférieurs du péristome. Ils s'étendent sur les médians, et s'avancent jusque sous la partie un peu postérieure des yeux. Dans plusieurs genres on voit, sous l'épistome une petite pièce semicirculaire, solide est bien détachée, qui recouvre la base antérieure de la trompe : c'est le chaperon (*clypeus*) des autres insectes. 4. La région postérieure, évidemment

lished that is *generally* applicable.<sup>d</sup> It will be of small service to name, with the greatest nicety, the parts visible in one genus or family. With exquisite talent Savigny has remarked, that naturalists multiply facts to admiration, but invariably decline generalizing them.<sup>e</sup> It is this generalizing, this universal application, that we stand in need of. We want a nomenclature that can be applied to all.

The only portion of the skull to which any general names can be attached, are these:—the *Epicranium*, or upper portion of the skull, of which the *Clypeus* or *shield*, and *Ocelli* or *simple eyes*, are constituent parts; the *Gula* or *throat*, which is the under portion of the skull, of which the *Mentum* or *chin*, is a constituent part;<sup>f</sup> and the *Oculi* or *eyes*, which are the lateral portions. The *neck*, of various authors, as applied to a part of the head, is nothing more than an elongation of the

composée de deux pièces larges, inférieures, et latérales, se trouve en contact avec la face antérieure du prothorax. Elle est percée d'un trou pour le passage des nerfs, des trachées et du tube digestif. A sa partie supérieure, entre les yeux, et au-dessus de ce trou, on doit distinguer le cérébral (*cerebrale*) ou la pièce qui fait suite au vertex et qui recouvre le cerveau. 5 et 6. Les yeux à réseau, ou les grands yeux forment les régions latérales de la tête. Ils offrent rarement quelque chose de remarquable et sont toujours entourés dans leur circonférence par les optiques, un peu moins développées en arrière qu'en devant.—*Desvoidy*.

<sup>d</sup> Le crâne du *Melolontha* est composé de six pièces soudées entre elles, et qui je nomme la pièce Epicrânienne, ou simplement l'Epicrâne, le Chaperon, la Basilaire, la Prébasilaire, et les deux Cornées des yeux. 1. La pièce Epicrânienne comprend la majeure parti de la tête, dont elle occupe principalement la région supérieure. 2. La Chaperon est une seconde pièce impaire de la tête, placée transversalement au devant du bord antero-supérieur de l'épicrâne, avec lequel elle se soude, et dont elle fait la continuation. 3. La pièce Basilaire, également impaire, occupe la partie inférieure et postérieure de la tête: sur les côtés, elle s'unit par suture avec l'épicrâne. 4. Je donne le nom de Prébasilaire à une quatrième pièce impaire du crâne, placée au-devant de la basilaire dont elle fait la continuation. 5 et 6. Les Cornées des yeux forment les seules pièces paires qui entrent dans la composition du crâne: ce sont deux calottes ovales, convexes, enchassées dans les deux grandes ouvertures latérales de l'épicrâne.—*Straus-Dürckheim*.

<sup>e</sup> Les entomologistes multipliaient à l'envi les observations; mais ils se dispensent de les généraliser; ils créaient chaque jour des genres nouveaux, et les premiers fondemens de cet édifice auquel ils travaillaient avec tant d'ardeur n'existaient point.—*Savigny*.

<sup>f</sup>. It will be seen by a reference to Latreille's last work, *Cours d'Entomologie*, that he finally decides the *mentum* to be a *portion of the skull, and not of the lip*; in fact, he declares that the part he means is the *prébasilaire* of Straus-Dürckheim. See *Cours d'Entomologie*, p. 204. Le menton ou ganache n'est que prolongement de cet espace inférieur et gulaire de la tête que M. Straus nomme *pièce prébasilaire*.—*Latreille*.

skull posteriorly.<sup>g</sup> If description requires more definite limits, parts may be intelligibly designated by their propinquity to other parts. The shield is that part of the skull which is immediately above the mouth, and whose office is to shield it from injury. It was considered by Fabricius a part of the mouth. It is described by him as a corneous porrected part of the head, covering the mouth above, horizontally. It is divided by him into two parts, the *disk* and the *limb*: the limb is the upper lip, the disk is the true shield.<sup>h</sup> It is called by Straus-Driückheim, &c., *chaperon*; by Kirby, *nose*. In *Lepidoptera*, the shield is little apparent; it is hidden by the scales. In *Diptera*, it is more readily distinguished. In *Hymenoptera*, it is very distinct; you will recognize it, in the large corneous piece embraced by the lower portion of the eyes in the hornet.<sup>i</sup> In *Coleoptera*, it is sometimes obscure, as in *Hydrous*;<sup>k</sup> sometimes very conspicuous, as in *Copris*. In *Orthoptera*, it is always distinct. In several orders of this class, the suture, uniting the shield with the upper part of the skull, is membranaceous; hence the lip and shield move simultaneously with the mandibles in mastication. This is a departure from a general law of nature, and its occurrence is well worth remarking; as the motion of the shield might induce an observer to suppose it the lip, which would consequently become a new and supernumerary elementary part.<sup>l</sup> In *Hemiptera*, it is frequently raised and conspicuous, but its limits are indistinct. In the central group, the dragon-flies, it is raised, conspicuous, distinct, and horizontally divided into two.<sup>m</sup> The *Epicranium* is the whole upper region of the skull, bounded in front by the shield when distinct; laterally, by the eyes; and behind, by the junction of the head with the *prothorax*. Its extent is greatest in *Coleoptera*;<sup>n</sup> least, in *Diptera* and *Neuroptera*.<sup>o</sup> The *Oculi*, or *eyes*, are large lateral portions of the skull, known to every one. The *Ocelli*, or *simple eyes*, are small, highly convex lenses, soldered into

<sup>g</sup> *Necrophorus*. Head, with a distinct neck.—*Stephens*.

<sup>h</sup> *Clypeus*. *Horizontalis capitidis pars cornea porrecta os superne tegens. a. discus b. limbus*.—*Fabricius*.

<sup>i</sup> Plate V. fig. 16. *æ.*

\* Plate V. fig. 1, and 3. *æ.*

<sup>l</sup> Je suis convaincue lorsqu'on aura mieux examiné la bouche des insectes, proprement dits, on trouvera quelle forme qu'elle affecte elle est toujours essentiellement composée des mêmes éléments.—*Savigny*.

<sup>m</sup> Plate V. fig. 15. *æ. æ.*

\* Fig. 3. *Æ.*

\* Fig. 15. *Æ.*

the top or crown of the skull. The *Gula*, or *throat*, is the portion immediately below the under lip, and extends to the union of the head with the *prothorax*. The fore-part of the throat is sometimes called the *mentum*, but has no fixed limit. The *mentum* of MacLeay is the *labium* of Fabricius.

The parts of the skull are these: the crown, the two eyes, the throat. These are the four divisions of a section.

I would propose these names for the—

FIXED PARTS OF THE HEAD.<sup>P</sup>

- (Æ) EPICRANIUM, or *upper part of the skull*.
- (æ) CLYPEUS, or *shield of the mouth*.
- (œ) OCELLI, or *simple eyes*.
- (Æ) GULA, or *throat*.
- (æ) MENTUM, or *chin*.
- (Œ) OCULI, or *eyes*.

MOVEABLE PARTS OF THE HEAD.

- (y) ANTENNAE, or *cranial feelers*.
- (j) OS, or *mouth*.

As before observed, the great development of one part necessarily requires the proportionate diminution of another part. A part increases or decreases in volume precisely as the organs it may bear require muscle for their guidance and government; on the (acknowledged) plan, that, for so much muscular exertion so much muscle must be provided, which muscle must occupy so much space. This is well illustrated by the head of insects. Professor Sang has prettily observed, that every instrument, whether it be for the generation or transference of power, has a best size and a best form. Nature, in the formation of her instruments, has always adopted that best size and best form. If her creatures wanted but to see, a globular eye floating in space might perhaps be the uniform character of the animal world. If to see and to eat, an eye and a mouth would be given. If to move swiftly in the air were desirable, wings must be supplied; if, on the earth, legs must be added; if in the water, fins. To carry all these organs,

<sup>P</sup> In this table the parts marked with small diphthongs are variable and inconstant; those with capital diphthongs are constant throughout the classes. The diphthongs and letters refer to figures in Plate V.

and to contain muscle to guide and govern them, a body must be added. Each part of the body will be of best size, and best form, for the functions it has to perform. We have seen that insects, in the *larva* state, have a very uniform allowance of muscle to each segment. In the *imago*, the charge of supporting the whole body in the air is entrusted sometimes to a single segment; and, in order to supply sufficient strength for the purpose, nature robs the neighbouring segments of their muscle, and gives it the one which needs it. In the head, the mouth, feelers and eyes operate, in the same manner, one on another. Observe the dragon fly, the emperor of his tribe:<sup>4</sup> his wings rustle as he hovers stationary and hawk-like in the air; his appetite is insatiable; his food, the active occupants of his own element,—it is given to him in charge to set bounds to the increase of the insect race; he beholds his prey afar off; he darts on it with the rapidity of a lightning-flash. To devour it, ere life is departed, is the work of an instant. He sails round and round; he soars up and up. When the sky is serene he seeks his prey, like the swallows, almost beyond the reach of human sight. What organs does such an animal require? Are they not these; eyes, mouth, and wings? How has Nature provided for his wants? Regard his head: below, it is all mouth; above, it is one continuous eye. Contemplate his wings: their character is strength and lightness, power and activity. His body is slender and graceful; like a rudder, it serves as an instrument wherewith to shape his course. Porrected feelers, whether cranial, labial, or maxillary, would be comparatively useless to an animal whose dependence for support is on the keenness of its vision and the velocity of its flight. We find them but little prominent; his every organ of the required size. The same law obtains as certainly and unvaryingly in form. There is truly a best size and a best form, and nature always provides it.

The fixed organs of the head, manifesting but slight variations, require no further comment. The *antennæ* or cranial feelers, and the mouth, are the only moveable organs. The *antennæ* are too well known to dilate on. The mouth must be considered more at large. The union of the head with the *prothorax* is by an articulation much more free than that between either of the following

<sup>4</sup> Genus *Anax* of Leach.

segments. Its power of motion is principally dependent on its relative size as regards the *prothorax*; sometimes it greatly exceeds that segment in size, and it is then loosely suspended at its extremity; sometimes it is much less than the *prothorax*, and received almost entirely within it, as a ball in a cup.<sup>r</sup>

The mouth of insects is essentially uniform. Its united parts work to the same end by different modes. Nature arrives at her object by the most direct means. Her plans are the perfection of simplicity. It may sometimes appear otherwise to us; that it does so is attributable to our ignorance, not her error. The construction of the mouth is peculiarly simple: even amid all the confused and laboured nomenclature with which descriptions of it have been loaded, its exquisite simplicity renders it intelligible to the meanest capacity. A celebrated lecturer well said, in allusion to the rage of the day for theoretical ideas and metaphorical allusions, "A stomach, gentlemen, is a stomach." In like manner, a mouth is a mouth, not a *proboscis*, nor a *haustellum*, nor a *trunk*, nor an *antlia*, nor a *promuscis*, nor a *tongue*, nor a *rostrum*, nor a *rostrulum*, nor a *rostellum*, but simply a mouth. The terms *haustellate* and *mandibulate*, as applied to the mouth of

<sup>r</sup> Dans les insectes l'articulation de la tête sur le corselet présente deux dispositions principales. Dans l'une les points de contact sont solides, et le mouvement est subordonné à la configuration des parties; dans l'autre l'articulation est ligamenteuse; la tête et le thorax sont réunis par des membranes. L'articulation de la tête, par le contact des parties solides, se fait de quatre manières différentes: 1. Où la tête porte, à sa partie postérieure, un ou deux tubercules lissés, que reçoivent des cavités correspondantes, dans la partie antérieure du corselet (*Scarabaeus*, *Lucanus*, *Cerambyx*, &c.), dans ce premier cas la tête est mobile d'avant en arrière: 2. Où la partie postérieure est absolument arrondie, et tourne sur son axe, dans une fossette correspondante, de la partie antérieure du thorax (*Curculio*, *Brentus*, &c.), la tête se meut en tous sens: 3. Où la tête est tronquée postérieurement, et présentant une surface plate, et articulée tantôt sur un tubercule du thorax, tantôt sur une surface aplatie et correspondante (presque tous les Hyménoptères et plusieurs Diptères, *Tabanus*, *Musca*, *Syrphus*, &c.) 4. Enfin, où, comme dans quelques espèces d'*Attelabes*, la tête se renverse en arrière par un tubercule arrondi, reçu dans une cavité correspondante du thorax; le bord de cette cavité est échancré et ne permet le mouvement de la tête que dans un seul sens. Il n'y a guère que dans les insectes Orthoptères, et dans quelques Neuroptères qu'on remarque l'articulation ligamenteuse: la tête, dans cette disposition articulaire, n'est gênée que dans ses mouvements vers le dos, par qu'elle est retenue par une avance du thorax, mais au-dessous elle est absolument libre. Les membranes ou les ligaments s'étendent du pourtour du trou occipital à celui de la partie antérieure du corselet, ce qui donne une grande étendue aux mouvements.—*Cuvier*.

insects, are unavailable as distinctive characters. To Clairville has been assigned the merit of distinguishing between these supposed different kinds of mouth. He does not deserve it. Aristotle remarks, that some insects possessed teeth for devouring every thing, whilst others had only a tongue for sucking liquids.<sup>s</sup> Fabricius was well aware of the distinction; he placed together the four classes, *Coleoptera*, *Orthoptera*, *Neuroptera*, and *Hymenoptera*; and in a separate group, *Lepidoptera*, *Hemiptera*, and *Diptera*.<sup>t</sup> Lamarck applied the distinction to divisions. Clairville named those divisions. Savigny investigated more thoroughly, and proved the difference to be rather apparent than real. Aristotle's was the observation of a true naturalist; that of Fabricius no less so; Lamarck's was the application of a systematist; Clairville's the clever and apt idea of a nomenclaturist; Savigny's the discovery of a philosopher. I have not happened to meet with, in print, a distinctive character by which these supposed groups can be separated. It is a dichotomous one. Like all dichotomies, it consists of a positive and a negative. It is this:—in the mandibulate classes the mandibles *do*, in the haustellate classes the mandibles *do not*, move horizontally. It has no reference to the possession of mandibles: all insects possess mandibles. The food can never reach the *oesophagus* without passing through an intermediate space. Its passage through this space is by suction; the space is called the *haustellum*. The butterfly and the beetle alike possess this *haustellum*; it varies only in length. Any difficulty in obtaining food, which the bulk of the head and body may occasion, is provided for by nature by an elongation of this *haustellum*. When, combined with this difficulty, the food is solid, the mouth is placed at the extremity of this *haustellum*, as in weevils. When the food is liquid, the parts of the mouth itself are elongated, and, united, form the *haustellum*, as in bees and butterflies. The caterpillar eats solid substances; its mouth is necessarily hard for their mastication: the bulk of its head and body offer no obstruction to its obtaining an ample supply of food; the passage to the *oesophagus* is short. The butterfly subsists on

<sup>s</sup> Τῶν δὲ ἐντόμων τὰ μεν ἔχοντα ὀδόντας, παρφάγα εστι· τα δε γλῶτταν μόνον τοῖς ὑγροῖς τρέφεται, πάντοθεν ἐκχυλίζοντα ταῦτη. Aristotle.

<sup>t</sup> This appears to have been the first division of this kind that is at all clearly defined.

fluids; its mouth requires no hardness; the bulk of its head and body offers an obstruction to its obtaining a sufficient supply of its food, which is generally concealed in the nectary of flowers; the passage to the *aesophagus* is lengthened, and the difficulty overcome. The caterpillar produces the butterfly; one is haustellate, the other mandibulate: they cannot be placed in separate classes. The mouth sometimes varies as much and as abruptly in the same insect in its different stages, as in any two different insects in their final stage. In others it remains nearly the same, or gradually approaches its perfection with every change of skin. In *Orthoptera* and *Hemiptera* the latter is the case: in these classes, every *ecdysis* is a *metamorphosis*; the food and economy undergo no change, the organs therefore require none. Nature never provides uselessly. Fabricius beautifully observes, that it is the part of the wise man to study these things; to observe, record, and add them to the stores of science; to weigh well the mysteries of Nature, and trace the hand of a Creator in the wonders of his creatures. Lamarck says, that each peculiar form has been acquired by degrees,<sup>u</sup> and by striving to attain a particular object.<sup>x</sup> He appears to have forgotten, that if honey had been denied to the bee until its little mouth had lengthened out into a thread-like tube, starvation and extinction of its race must have been the consequence. Kirby, in reference to this, exclaims, It is grievous that this eminent zoologist, who in other respects stands at the head of his

<sup>u</sup> La nature, dans toutes ses opérations, ne pouvant procéder que graduellement, n'a pu produire tous les animaux à-la-fois: elle n'a d'abord formé que les plus simples; et passant de ceux-ci jusqu'au plus composés, elle a établi successivement en eux différents systèmes d'organes particuliers, les a multipliés, en a augmenté de plus en plus l'énergie, et, les cumulant dans les plus parfaits, elle a fait exister tous les animaux connus avec l'organisation et les facultés que nous leur observons.—*Lamarck. An. sans Vert.*

<sup>x</sup> Premièrement, quantité de faits connus prouvent que l'emploi soutenu d'un organe concourt à son développement, le fortifie, et l'agrandit même; tandis qu'un défaut d'emploi, devenu habituel à l'égard d'un organe, nuit à ses développemens, le deteriore, le réduit graduellement, et finit par le faire disparaître, si ce défaut d'emploi subsiste, pendant une longue durée, dans tous les individus qui se succèdent par la génération. On conçoit de là qu'un changement de circonstances forçant les individus d'une race d'animaux à changer leur habitudes, les organes moins employés dépérissent peu à peu, tandis que ceux qui le sont davantage, se développent mieux et acquièrent une vigueur et des dimensions proportionnelles à l'emploi que ces individus en font habituellement.—*Lamarck. Phil. Zool.*

science, should patronize notions so evidently absurd and childish. Cuvier wisely remarks, that there is no proof that the differences which at the present day distinguish animals from each other can have been produced by circumstances.

Thirty years ago, in this country, we were so bound by the fetters of the Linnæan system, that the mouth of insects was never resorted to as likely to afford distinctive characters. Our great writers in their generic descriptions make no allusion to it. Marsham's<sup>y</sup> *Coleoptera*, and Haworth's<sup>z</sup> *Lepidoptera*, at this day the only continuous descriptive lists of the species of whole classes that we possess, are dependent for their principal characters on the antennæ alone. At the present time it is far otherwise. The value of the mouth, in furnishing characters, is well known: its anatomy, therefore, cannot be a matter devoid of interest.

The mouth of insects I have already traced to three sections; the lips, the maxillæ, and the mandibles. I am now about to consider it in another light, as consisting of seven primary parts, as under;—

- No. 1. (a) LABRUM, or *upper-lip*, bearing inferiorly the ( $\hat{\alpha}$ ) EPIPHARYNX, or *valve*.
- 2. (u) LABIUM, or *lower-lip*, bearing the ( $\hat{\alpha}$ ) LABIPALPI, or *labial-feelers*, and, moreover, divided into:—
  - (u 1.) INSERTIO, or *insertion*, (*stipes* of MacLeay).
  - (u 2.) LABIUM, or *true lip*, (*mentum* of MacLeay).
  - (u 3.) PALPIGER, or *feeler-bearer*.
  - (u 4.) LIGULA, or *limb*, (*labium* of MacLeay).
- 3 & 4. (i) MANDIBULÆ, or *mandibles*.
- 5 & 6. (o) MAXILLÆ, or *feeler-jaws*, bearing the ( $\hat{\delta}$ ) MAXIPALPI, or *maxillary-feeler*, and the ( $\hat{o}$ ) GALEA, or *helmet*, and divided into:—
  - (o 1.) INSERTIO, or *insertion*.
  - (o 2.) MAXILLA, or *true feeler-jaw*,
  - (o 3.) PALPIFER, or *maxillary feeler-bearer*
  - (o 4.) LACINIA, or *blade*.
- 7. (e) LINGUA, or *tongue*, (*hypopharynx* of Savigny).

The whole of these parts are not equally developed. The

<sup>y</sup> *Scarabæus*. Antennæ clavatae, capitulo fissili.—Marsham.

<sup>z</sup> *Papilio*. Antennæ versus apicem clavato-capitatae, in sectione ultima plus minusve uncinatae.—Haworth.

mode of their development affords characters by which classes are distinguished; the degree of their development, and the variation of their form, those for subordinate divisions. The diminution of a part until it escapes our notice is no proof of its non-existence; otherwise, the discovery of a part by a highly-magnifying power might be termed its creation. In the foregoing table, it will be seen that there are some parts originating in, and totally dependent on, the others. These are the feelers and *galea*; which may be termed secondary parts. Now secondary parts cannot exist without the primary parts which bear them. The presence of labial-feelers ensures a *labium*; the presence of maxillary-feelers ensures a *maxilla*. I feel considerable hesitation in considering the tongue, or *hypopharynx* of Savigny, a primary part. It is, however, of little moment what nominal value we may set on it. Its importance is precisely that of the tongue in the human mouth. It originates at the *pharynx* in common with the two lips, and is a portion of the same section.

The situation of the mouth is commonly in the lower part of the head, a little forward, calculated for feeding readily while the head is naturally inclined; it is bounded above by that part of the skull called the *clypeus*, and below by that part termed the *mentum*, from both of which it is perfectly distinct. I will now endeavour to trace the variations of its parts.

The first part of the mouth is the *LABRUM*, or *upper lip*. Fabricius, in describing this part, is very inaccurate. He has confounded it with the *clypeus*. He describes its variations in different genera. He alludes in one genus to the *clypeus*, in another to the *labrum*; in a third he unites the two. You will remark, it is never sutured to the skull; it is always free, moveable, and distinct. It unites with the lower-lip, and forms with it a distinct section. It bears on its under side the *Epipharynx*. It is usually an osseous piece, freely articulated to the *clypeus*, and originating below and within it. It is of variable shape; never palpigerous; and it serves as a cover to the other parts of the mouth. In *Lepidoptera*, the upper-lip is an unimportant part, and appears to have escaped the notice of naturalists, until detected by the accurate Savigny.<sup>a</sup> It is a thin flat scale-

<sup>a</sup> On voit d'abord que la lèvre supérieure doit être très petite et très peu apparente; elle est mince, membrancuse, quelquefois demicirculaire, mais le plus

like piece, projecting but little beyond the *clypeus*. It is generally pointed; and its under surface or *epipharynx* is formed to fit exactly the aperture at the base of the feeler-jaws. It has thus partially the power of a piston, and assists in drawing fluids through the tube formed by the united feeler-jaws. In *Diptera*, the parts of the mouth are generally very obscure; but when a peculiar mode of feeding requires active exercise, you will find they are called into very obvious existence, and each becomes fully developed. The *Diptera*, like the *Lepidoptera*, live principally by suction; but unlike them, have frequently to pierce the cuticle of the object, the juices of which they seek to extract. This operation calls into action organs which were dormant in the honey-sucking butterflies. The blood-suckers among *Diptera* offer the best examples of a developed mouth. The upper-lip is large, long and sharp-pointed in *Tabanus*.<sup>b</sup> In *Culex*, it is longer still, and more slender. If equal development of the primary parts constitutes perfection in the mouth of insects, then *Tabanus* and *Culex* may be said to possess perfect mouths. In these the primary parts are equally developed. In *Sphaeromias*, and other nearly allied genera, you will find the upper-lip deeply grooved beneath, and partially receiving the other organs, as in *Hemiptera*. In *Rhyphus*, it has a tendency to the same form. In the *Asilites*, it is plain, stiff, and but half the length of the other organs. In the *Empites* it is long, and forms the outer cover of the beak of these insects. In *Medeterus*, if I have not mistaken, it is palmate; the central lobe being longest, the next to it next in length, and the external ones shortest. In *Oestrus*, the *labrum* and whole mouth have disappeared. Clark, in his valuable Essay on the Bots of Horses, speaks of the mouth of *Oestrus* as a simple aperture;<sup>c</sup> thus implying the existence of a *pharynx*; I confess I have not found it. Desvoidy appears to have a new theory regarding the mouths of *Diptera*. If it prove correct, nearly all the received nomenclature must fall.<sup>d</sup> In *Hymenoptera* the upper-lip is short,

souvent allongée en pointe, appliquée contre la base de la trompe et reçue dans la suture moyenne de manière à fermer exactement le léger écartement qui se trouve entre ses deux filets.—*Savigny*.

<sup>b</sup> In Plate VI. is represented the mouth of *Tabanus bovinus*.

<sup>c</sup> Os, apertura simplex, neque ullo modo exertum.—Clark.

<sup>d</sup> La trompe (proboscis) des Diptères, selon moi, n'est point formée par la

solid, bony, and somewhat quadrate. Unlike the same part in *Diptera*, it cannot be bent without injury. It either retains the bend or it breaks. It is not always visible externally. In the bee it is conspicuous : in the wasp it is hidden by the *clypeus*. In *Coleoptera* it retains a similar character. It varies much in development. The *Scarabæites* have the upper-lip small. I cannot consider, with Olivier, that it is in any case absolutely wanting,<sup>e</sup> although the great stag-beetle is almost without it. In these orders<sup>f</sup> the *clypeus* supplies its place : whence the error of Fabricius in confounding the two. In the rapacious beetles it is large. In *Anthia* and *Cicindela* it is very conspicuous. In all water-beetles it is fully developed ; the difference in their economy does not affect it.<sup>g</sup> In *Orthoptera* its character continues the same, its relative size larger. In *Hemiptera* it has changed. It continues rigid, and is injured by bending : but it is longer and more pointed than in the three preceding classes. It is grooved to receive the *labium*, and is the only part of the mouth that is detached. In *Issus* it is sharper than a needle. In the other *Cicadites* it is more obtuse. In the *Cimicites*, again, it is sharp ; and the same in the *Nepites*. The mouth in *Neuroptera* has no common character. Neuropterous orders, with the exception of the central one, *Libellulites*,<sup>h</sup> assimilate in all their characters to the classes to which they approach. I cannot, therefore, detail

lèvre inférieure, comme celle des Hyménoptères, mais par les mâchoires. Dans les *Myodaires*, elle est ordinairement membraneuse, quelquefois solides et triarticulée. La base est enveloppée par la base de la lèvre inférieure, dont les deux palpes sont toujours développées, et qui se prolonge en deux supports latéraux et ordinairement solides. Le corps de la trompe se prolonge en une gaine, terminée par des lèvres membraneuses dues à des trachées très développées, et par des palpes qui peuvent être solides. Elle renferme deux filets allongés qui forment le sucoir et qui représentent les mandibules. La pièce plus ou moins solides qui se prolonge sur la rainure de la trompe est le labre ou la lèvre supérieure.—*Desvoidy*.

<sup>e</sup> Les Scarabées qui ont des mandibules, et qui n'ont point de lèvre supérieure.—*Olivier*.

<sup>f</sup> *Scarabæites* and *Lucanites*.

<sup>g</sup> In water beetles the *clypeus* is never distinct.

<sup>h</sup> La labre demi-circulaire vouté ; deux mandibules écaillueuses, très fortes et très dentées ; des mâchoires terminées par une pièce de la même consistance, dentée, épineuse et ciliée au côté interieur, avec une palpe d'un seul article, appliqué sur le dos, et imitant la galète des Orthoptères, une lèvre grande, voutée, à trois feuillets, et dont les latéraux sont des palpes ; une sorte d'épiglotte ou de langue vesiculaire et longitudinale dans l'intérieur de leur bouche.—*Latreille*.

their peculiarities. To describe a single order would be merely to mislead; to describe all would be extending my letter to an unreasonable length.

The LABIUM or lower lip corresponds with the upper lip. It occupies the same situation below the jaws that the upper lip holds above them. The upper and lower lips therefore close the mouth vertically. There is no part of the mouth concerning which writers are so little agreed as this. The difficulty has arisen in two ways;—first, from the number of its parts; secondly, from the propinquity of similar parts. The lower lip is a compound and somewhat complicated organ. Every one has seen this; and every one has been desirous of applying some name to each of its parts. The next organ above it is the *tongue*; the next part below it is the *mentum*. It is not much to be wondered at that entomologists finding these three names—finding three very distinct parts in the lip—and moreover, very frequently finding no distinct tongue or *mentum*, should have applied the three names, *tongue*, *lip*, and *mentum* to the three most conspicuous and manifest divisions of the lip. The name *mentum* was given by Réaumur. Now the names of Réaumur impose no law: did they, half our present nomenclature must be abandoned. Latreille has, however, decided on retaining the name, and has applied it to the part of the throat immediately adjoining the mouth. The lower lip is divisible into four portions:—the *Insertio* or *insertion*; the *Labium* of Fabricius, or *true lip*; the *Palpiger* or *feeler-bearer*; and the *Ligula* of Fabricius, or *limb*. Of these, the *palpiger* appears to be now noticed for the first time. The *insertion* is precisely what the name implies; it is, in fact, the root by which the lip holds. It is always, in a greater or less degree, concealed by the *mentum*. Savigny has called it *support* and *insertion*. MacLeay, it will be seen, has named it *stipes*;—a name not inapplicable to the particular instances in which he figures it. The true *labium* is the second part: it is thus named by Fabricius, and has since been erroneously termed the *mentum* by most modern entomologists. The *palpiger*, or *feeler-bearer*, is situated above the disk, and is very often confounded with it. It seems generally to be a mere fleshy fold, between the lip and the *ligula*, but is occasionally thrust out far beyond the lip, and assumes the appearance of a *ligula*. In these instances it is easily detected by the feelers which it bears on its summit.

The feeler-bearer is seldom elongated without a similar elongation of the *ligula*. The *ligula*, or limb, is the fourth and terminal portion of the lip; its names have been most numerous. Its variations in form are very striking, and afford excellent generic characters. The two lips are united at their base. The nearer we can approach to a perfect tetrapterous hexapod, the more clearly will this be demonstrated. The type<sup>1</sup> of a tetrapterous hexapod we may yet be unacquainted with. Such a type must exhibit each organ fully developed. Our large dragon-flies are the nearest approach we know of to full and equal development of principal primary organs; in these we clearly perceive that the two lips are but a single piece, of which the central portion is flexible and fleshy, and perforated by a circular aperture, known as the *pharynx*. Let us now trace the variations of the lower lip.

In *Lepidoptera*, the lower lip is usually a triangular piece, the base of which is closely united to the inferior region of the skull.<sup>k</sup> Its surface is uniform, and its divisions obscure. Its apex is generally acute, and terminated by a single point: yet sometimes, as in *Amaryssus*,<sup>1</sup> it is bidentate. The labial-feelers arise from it in nearly an erect position, one on each side of the feeler-jaws, which form a small ring between them. Although obscure, the divisions of the lip are manifest under a good glass. The genus *Ino*, of Leach, exhibits very evident lines across it, which show with sufficient accuracy the limits of each division. The margin of the *insertion* rises to a level with the anterior margin of the *mentum*. The *labium* is a narrow arcuate piece, situated above this, and bordering the insertion of the feelers. The *feeler-bearer* is another narrow piece, whose margins, centrally, are nearly connate, laterally dilated for the reception of the feeler. The *ligula* is very considerably larger than the other divisions of the lip: it is triangular, with a very acute apex. The *feelers* in this genus, as figured by Savigny, exhibit a basal joint, in addition

<sup>1</sup> By the word *type* I would imply the perfection of a peculiar kind. Hexapods, approaching spiders, or *Ametobola*, for instance, would be departures from types.

<sup>k</sup> Je dirai peu de choses de la lèvre inférieure: elle consiste en un simple plaque triangulaire, ordinairement écailluse, unie par une membrane aux deux tiges des mâchoires, et supportant à sa base les deux palpes que tout le monde connaît.—Savigny.

<sup>1</sup> *Papilio Machaon*.—Lin.

to the two usually described. The apex of the *ligula*, and the form of the articulations of the feeler, seem to be the only portions of the lip in this class that are likely to be available for generic distinctions.

In *Diptera*, the lower lip is the largest and most conspicuous portion of the mouth. It is the organ known to every one, with which the busy house-fly attacks our sweets. It is not unfrequently termed the *proboscis* of the fly, a term, however, applied by Meigen to the united mouth of *Culex*.<sup>m</sup> Desvoidy, as already stated, has another idea about the anatomy of this organ. The *ligula* of *Hymenoptera*, shortly to be noticed, appears to have a precise analogue in the incrassated bilobed termination of the lip of *Diptera*. Immediately below this, in the genus *Tabanus* and some neighbouring groups, may be seen on each side of the lip a pilose excrescence. Savigny considers this the labial-feeler. It is the very situation in which analogy will lead us to look for this organ; and the idea that it is such is, consequently, far from improbable. I have, with great pains, sought for some character, whereby I might with confidence confirm Savigny's opinion, but have been unsuccessful: there appears no trace of articulation. By a careful examination, and frequently turning the object in the light while the eye is fixed on it, a nearly direct line will be seen crossing the lip immediately below these excrescences, thus separating, as I conjecture, the feeler-bearer from the true *labium*. The *insertion* is distinct; it has been noticed and figured by Savigny and others. The divisions of the lip are more prominent in *Empis*, *Stomyxis*, *Rhingia*, &c. than in *Tabanus*; yet still sufficiently indistinct, and scarcely to be recorded with certainty. The conspicuous presence of four divisions in the lip of *Hymenoptera*, *Coleoptera*, *Orthoptera*, and *Hemiptera*, led me to expect them in *Lepidoptera* and *Diptera*. Let me not influence the judgment of others. I have satisfied myself by patient investigation: I hope my fellow-labourers will do the same. With the exception of the *ligula*, the lip of *Diptera* affords but few characters for generic descriptions.

We now arrive at the *Hymenoptera*. Here the lower lip reaches its maximum. Let us examine the mouth of *Bombus*, the humble-bee. This mouth, if neatly spread out, presents

<sup>m</sup> *Culex. Proboscis porrecta, longitudine thoracis.*—Meigen.

us with the branching appearance of a little tree. Let us part off the outer branches, right and left: these branches are the feeler-jaws, to be noticed presently. After the removal of these, we find a long stalk or stem. At its base is a portion, very distinct, of a triangular form, with the apex pointing downwards. To the interior of this triangle the feeler-jaws are very firmly attached, and are with difficulty removed without carrying it with them. From the base of this triangle, which you will recollect is looking upwards, rises the true lip, a long slender piece with nearly parallel sides: near its summit a distinct and tolerably direct line crosses it; this line terminates the true lip: above it is the feeler-bearer. From each side of the feeler-bearer spring the feelers; throughout this order very elongate and conspicuous. From the summit of the feeler-bearer rises the *ligula*,<sup>n</sup> trilobed; each lobe is distinct to the very base; the lateral ones are called *paraglossæ*, a name that appears redundant, unless it could be carried through all the orders of this and the two following classes. In *Nomada* the lip is broad, the central lobe of the *ligula* large and moderately long; the lateral lobes small, and very acute. The labial-feelers are distinctly quadriarticulate, and longer than the central lobe of the *ligula*. In *Saropoda* the lip is similar, the feelers indistinctly articulated; and these, together with the central lobe of the *ligula*, much more elongate. In *Bombus* the central lobe of the *ligula* is much longer than the feelers. In *Melceta* the lip is longer than the *ligula*. In *Cælioxys rufescens*<sup>o</sup> the *ligula*, in its central lobe, is much shorter than the feelers; its lateral lobes are rudimental. In *Osmia* the central lobe of the *ligula* is nearly three times the length of the lip, and twice the length of the feelers; still the lateral lobes are very minute. In *Anthidium manicatum* the central lobe of the *ligula* and the feelers are exactly of a length; the lateral lobes of the *ligula* are thin, short, and scale-like. In *Audrena*, *Halictus*, *Dasyppoda*, *Colletes*, *Hylæus*, and *Sphecodes*,<sup>p</sup> the *ligula* is not a quarter of the length of the lip.

<sup>n</sup> *Ligula*. This is the part considered by many authors as the lower lip.—*Samouelle*.

<sup>o</sup> An insect common in the south of England, but one which I think has not found its way into our British lists.

<sup>p</sup> *Sphecodes monilicornis* excepted; which will probably form a new genus, or be removed from this.

In these instances it is quadrifid. Leaving the bees, we shall find the *ligula* in *Odynerus*, *Eumenes*, and *Epipone*, elongate and quadrifid; the feelers also differ essentially from those of the bees, in being situated considerably below the union of the lobes of the *ligula*. The lips of fossorial *Hymenoptera* are shorter than those of the foregoing; the *ligula* is usually short, obtuse, and bifid; the feeler-bearer variously developed, and the feelers much longer in proportion. The *Ichneumonites*, and other parasites, are very similar; the tongue being generally bifid and much shorter than the feelers. Lastly, in the *Tenthredinites*, we find distinctly trilobed *ligulae*, short lip, and long feelers.

In *Coleoptera* the lip is reduced in length, but in all other respects it is very close to that of *Hymenoptera*. Latreille gives the name of *labium* to the whole lower lip in *Coleoptera*. MacLeay calls the same part *mentum*; but, reluctant to relinquish the Fabrician term, *labium*, has applied it to the *ligula*. Kirby<sup>a</sup> calls the whole lip, *labium*, but follows MacLeay in the nomenclature of its parts. Curtis, whose beautiful work, entitled "British Entomology," is known to every entomologist in this country, follows the nomenclature<sup>r</sup> of MacLeay. The labial feelers of *Coleoptera* are four-jointed. The basal joint is very various in its development. This circumstance is a fruitful source of confusion. The *ligula* originates at or near the *pharynx*. It extends along the inner surface of the lip, to which it is closely attached, and stretches beyond it. The produced portion being in the nomenclature of Fabricius, the limb of the lip, and sometimes the *ligula*, is the only part available for characters. The feeler-bearer in the lip of *Coleoptera* is soft and fleshy, and is remarkable for the variety of its development; and the feelers are attached to it by a loose and flexible articulation. Now, this being the case, you will observe, that the elongation of the *ligula* is very likely to affect the position of organs so situated. Let us examine this. In *Cicindela* the lip has three lobes; the central acute, the lateral ones obtuse. In the spaces between these are situated the feelers; there is no produced feeler-bearer, nor *ligula*. We will next

<sup>a</sup> In the *Coleoptera* only I speak of. The *labium* of *Coleoptera* is, in Kirby's nomenclature, the *lingua* of *Hymenoptera*. In *Orthoptera* and *Neuroptera* I am not competent to offer any explanation of this author's nomenclature of these parts.

<sup>r</sup> In the majority of the *Coleoptera*. In the other classes there is but little uniformity in the nomenclature of parts.

examine *Cychrus*. The middle lobe of the lip seems to be completely cut away; and the feeler-bearer appears in its place, with a pair of closely-approximating feelers rising from its summit. Turn the other surface of the lip, and apply a good lens: you will find the trilobed *ligula*, minute indeed, but beautifully distinct; the lateral lobes being rather longer than the central lobe, and termed by Latreille *paraglossæ*. *Blethisa* and *Nebria* present a very similar structure, except in the central lobe of the *ligula*, which in these is large and somewhat rounded. In *Helobia* the central lobe has a central tooth. In the *Harpalidæ* and *Scaritidæ*, the *ligula* is generally more produced; and the feeler-bearer and feelers are carried with it. In *Licinus*, the lip and its appendages are similar to those of *Cychrus*. You will find the same similarity in the feeler-jaw and its appendages. In the *Dytiscites* no great difference appears; the lateral lobes of the *ligula* are however mostly obsolete. In the *Hydrophilites* the lip is less indented than in predaceous beetles; the *ligula* is frequently bilobed, and the feelers appear to lose one joint by the second being received into a cup formed by the first. In *Hydroïs*, the feeler-bearer appears obsolete; and the insertion of the feelers behind the lip actually swells out the portions of its margin, behind which it enters. In *Parnus*, supposed to be nearly related to *Hydroïs*, the feeler-bearer and feelers project far beyond the lip. In *Tetratoma*, and *Cis*, the feeler-bearer is raised, but the *ligula* is concealed. In *Leiodes* all the four parts are distinctly developed. In *Trox*, the insertion is peculiarly prominent; and still more remarkably so in *Acanthocerus*.<sup>\*</sup> In the vast order, *Circulionites*, I find the feeler-bearer very prominent and elongate; yet the *ligula* is mostly obsolete or concealed. In Curtis's figure of *Monychus* there appears to be a distinct *ligula*;—I have never investigated the mouth of this genus. It seems a general character of the order, that the feeler-bearer should be prominent and elongate, the feelers approximate, placed at its summit, and occupying the usual situation of the *ligula*. In the *Cerambicites*, the four parts of the lip are very distinct: in *Saperda*, and *Hematicherus*, particularly so. The remaining

\* *Mentum quasi e duplii parte formatum, aliâ apiculi cordatâ ad basin, truncatâ, carinatâ, margine antico emarginato, lateribus rotundatis, elevatis; alterâ prioris stipite transversâ, concavâ, margine antico recto, linearî.*—*Macleay.*

orders of *Coleoptera* exhibit many variations in the parts of this organ, but mostly analogous to those described.

In *Orthoptera*, the lip has the same development as in *Coleoptera*, but the *ligula* is much more produced. It is divided into four lobes, somewhat palpiform. The common cock-roach presents an instance of this. The feelers are four-jointed; the basal joint occasionally amalgamating with the feeler-bearer.

In *Hemiptera* the lower lip wraps itself round the mandibles, &c., forming a sheath for them. It is four-jointed. Savigny considers the basal joint to be the true lip,<sup>1</sup> if I comprehend rightly his meaning. Latreille, in his last work, still treats of the lower lip as a quadri-articulate sucker, assigning no names to the articulations. I suppose the four joints to be analogous to the insertion, *labium*, feeler-bearer, and limb, observable in *Hymenoptera*, *Coleoptera*, and *Orthoptera*. Savigny has figured what he considers the feelers of *Hemiptera*, on the part which I have called the feeler-bearer. Willing as I must be to prove the correctness of this idea, I am compelled in fairness to admit that I have never made them out to my own satisfaction. The lower lip in *Hemiptera* varies scarcely at all, except in length. In the Linnæan genus, *Aphis*, several instances occur of its being twice as long as the body, passing beneath it, and projecting beyond it, like a tail.

In the larvæ of the *Libellulites* the lower lip has a most wonderful development, and all its parts are very conspicuous; the insertion is short, but distinct; the *labium* is long, stout, and incrassated externally; the feeler-bearer is still more developed, in *Æschna*, it is full half an inch in length, and divided into two lobes; the feelers are prehensile and mandibuliform; in fact, much resembling the mandibles of *Cicindela*; the *ligula* is a thin plate spread over the interior surface of the feeler-bearer, and filling up the space which occurs between its lobes. The most remarkable character of this extraordinary lip is its articulation. The *labium* is so freely articulated to the insertion that it is capable of being bent under the body of the insect reaching to the *metacoxæ*. The articulation of the feeler-bearer to the *labium* is of the same kind; while the latter is bent below the insect, the former is directed forwards, and reaches to the front of the mouth;

<sup>1</sup> Elle (la lèvre inférieure) est composée de quatre articulations, dont la première représente la ganache des *Coléoptères* et des *Orthoptères*.—Savigny.

the two joints thus reposing in parallel lines. The lower lip is the organ with which this ferocious larva seizes its prey. The perfect dragon-fly has also a singular development of the labial feelers: the lip itself is however little different from that of *Lepidoptera*; but the broad mandibuliform feelers are evidently used as organs of prehension and detention of their living prey, as I have often observed on feeding these insatiable creatures with flies whilst holding them by the wings. *Raphidia* displays the three lower parts of the lip in equal development; the *ligula* is concealed behind the feeler-bearer.

Next in order come the MAXILLÆ, or *feeler-jaws*; they are situated in the lower part of the mouth, one on each side, immediately above the lower lip, and below the mandibles, from which they may be instantly distinguished by constantly bearing the *maxipalpi*, or maxillary feelers. This distinction is so evident and unvarying, that I hope I shall be pardoned for applying to them the term, *feeler-jaws*; a term rather uncouth, I admit, yet I think also very distinctive and descriptive. The word *maxillæ* appears to offer no other translation than simply *jaws*, which would not sufficiently distinguish these organs from the mandibles. The feeler-jaws are less liable to variation than any other part of the mouth.<sup>u</sup> Their variations are therefore most important. Fabricius, Latreille, MacLeay, &c., have borne testimony to their value in affording distinguishing characters. Each feeler-jaw is divisible into four parts, the *insertio*, *maxilla* or disk, *palpifer*,<sup>v</sup> and *lacinia*. Straus-Dürckheim has the merit of first distinguishing these.<sup>x</sup>

\* Maxillam constantissimum invenimus, vix in congeneribus aberrat. — *Fabricius*.

Pièce *palpifère* of Straus-Dürckheim.

\* Chez les *Melolontha* le corps de la mâchoire est formé de quatre pièces, mobiles les unes sur les autres, mais qui n'ont point encore été décrites. L'une d'entre elles fixe la mâchoire sur la basilaire: c'est une pièce à peu près trapezoïde, portant à son petit côté parallèle un condyle articulaire, qui pénètre dans la cavité cotoïde interne qu'on remarque sur l'apophyse antérieure de la basilaire. De ce point d'articulation cette première pièce se porte transversalement en dehors, et va s'unir par son bord opposé aux autres pièces du corps de la mâchoire, d'où je lui donne le nom de *Branche transverse*. — La pièce *Dorsale* des mâchoires est chez tous les coléoptères une plaque presque plane, en triangle isocèle; elle est unie par son petit côté à la branche transverse, et de cette articulation elle se porte en avant et détermine la direction de la partie principale du corps de la mâchoire, dont elle occupe la face externe. Par son bord interne cette seconde pièce s'articule linéairement avec une troisième, placée à la face inférieure de la mâchoire, et que je nomme *l'Intermaxillaire*, et son bord externe

The *insertion* is almost invariably concealed. Savigny has called it also *support*. Kirby, if I understand him rightly, has denominated it the *cardo*, or *hinge*.<sup>y</sup> The *disk* and *feeler-bearer* are commonly two pieces running nearly parallel with each other; the former occupying the front, the latter the back of the jaws. It has unfortunately happened, that Straus-Dürckheim has selected for his dissections an insect, in which the situation and proportions of these two parts are very unusual, whence, in different formations, his names appear rather defective. The *palpifer* bears on its back the *maxipalpus*, or maxillary feeler. The fourth part is the *lacinia*, or *blade*. It is called by Savigny, *lame*; by Straus-Dürckheim, *intermaxillaire*; by Latreille, *internal lobe*; by MacLeay, *lacinia*. It is certainly the *lacinia* of Fabricius, as applied to a butterfly. United to the back of the blade, is the *galea* or *lobe*, a part exceedingly variable; sometimes bearing the appearance of a true feeler, and sometimes being wholly obsolete. It has been called, in the *Carabites*, the internal feeler; in the *Scarabæites*, the outer lobe of the feeler-jaw.<sup>z</sup> The name *galea* was given to it by Fabricius. This writer also treated of it as an inner *maxipalpus*. In *Lepidoptera*, the insertion of the feeler-jaws offers nothing

s'articule avec la quatrième, que j'appelle la pièce *Palpifère*. L'*Intermaxillaire* occupe comme nous venons de le dire la face inférieure de la mâchoire, et forme en même temps son bord interne: elle se prolonge peu au-delà de la pièce dorsale, et forme en dessous une large plaque allongée, qui s'étend vers le milieu de son bord interne en une longue apophyse dentiforme, dirigée obliquement en avant et en dedans. L'*intermaxillaire* s'articule en dehors avec la dorsale; à côté de son apophyse, avec l'angle interne de la pièce *palpifère*; à son bord interne elle est liée par un espèce membraneux avec la *galea*; enfin, son bord postérieur se continue avec le pharynx. La pièce *Palpifère* occupe la face supérieure de la mâchoire, et se trouve contiguë à la mandibule. C'est une grande plaque, à peu près triangulaire, articulée par son bord externe avec la pièce dorsale; par l'antérieur avec la *galea*; par l'angle interne avec l'*intermaxillaire*; et enfin son bord postérieur se continue avec le pharynx. Cette pièce forme ainsi avec la dorsale et l'*intermaxillaire* une chambre ouverte, d'une part, du côté de la branche transverse, par où elle communique avec la cavité de la tête, et, d'une autre, avec le *galea*. Sur l'angle antéro-externe de cette pièce est articulé le palpe, qui forme le principal appendice de la mâchoire.—Straus-Dürckheim.

<sup>y</sup> At their base they articulate with a piece more or less triangular, which I call the hinge (*cardo*). This, on its inner side, is often elongated towards the interior of the base of the *labium*, to which it is probably attached. This elongate process of the hinge in *Apis*, *Bombus*, &c., appears a separate articulation: and the two together form an angle upon which the *mentum* sits, and by this the *maxillæ* acts upon the labial apparatus.—Kirby.

<sup>z</sup> C'est une *rose* pièce mobile qui termine la mâchoire.—Straus-Dürckheim.

worthy of remark. The disk and feeler-bearer are closely connected, the suture uniting them being obliquely longitudinal. In treating of these parts, I believe it will be better to consider them but as one. Their distinctness is more clearly to be discerned from actual examination of the objects themselves, and from the accurate plates of Straus-Dürckheim, Savigny, &c., than from any verbal description. The blade is long, slender, pliable, and capable of rolling up like an Ionic volute, or the main-spring of a watch. This is a principal character of the class. When at rest, the blade appears to be a small ring, and is situated between the labial feelers. Each blade, when examined, is found to be externally convex, internally concave; so that the two, united together in front, form a tube. Through this tube, the honey of flowers is drawn. Each blade is also in itself a tube. The organ formed by the union of the two is very elastic; and, if artificially drawn out to its full length, will, on being loosed, instantly return to its natural position. The maxillary feelers are by no means a prominent portion in the mouths of *Lepidoptera*. They are situated one on the feeler - bearer of each feeler - jaw. Réaumur, a hundred years ago, noticed the maxillary feelers of *Lepidoptera*,<sup>a</sup> and figured them very accurately; but Savigny appears to have been the first scientifically to ascertain their identity. Though not prominent, they afford the best characters for dividing this class that we at present possess. The *galea*, or *helmet*, is still undiscovered. In the *Sphingites* I find no feeler: I conclude, therefore, it is nearly obsolete. In *Zygæna*, *Ino*, *Glaukopis*, *Pyrausta*, and all the *Pyralites* and *Crambites*, it is distinctly visible, generally without a glass, and appears to be typically three-jointed. In the *Tortricites* and *Tineites* the maxillary feelers are less distinct, but always present. In the *Noctuites* they are small and two-jointed. In the *Geometrites* they are still less conspicuous. In the *Papilionites*, less still: in *Amaryssus Machaon*, obsolete.<sup>b</sup>

<sup>a</sup> Dans la figure on peut remarquer deux barbes plus écartées l'une de l'autre que ne le sont communément celles des autres papillons: deux filets placés entre les barbes, et dirigés dans un sens contraire à celui où les barbes le sont.—Réaumur.

<sup>b</sup> Savigny's figure of the maxillary feeler in *Amaryssus Machaon* represents rather the site of the feeler, than the feeler itself. I have hunted for it in vain in the specimens I have dissected.

The blade of the feeler-jaw, in the class *Lepidoptera*, appears to vary only in length.

In *Diptera*, the feeler-jaws are generally of about equal length with the upper lip and mandibles, but are shorter than the lower lip. They are straight, sharp-pointed, and lancet-like. It does not appear that they are generally tubular. The insertion of the feeler-jaws in *Diptera* presents little worthy of notice. The disk and feeler-bearer are two small pieces, placed above each other; from the latter proceeds a feeler with from two to five articulations. The blade is the long sharp-pointed part. The helmet is apparently obsolete. The feeler-jaws fluctuate greatly in their development in the various orders and families of *Diptera*. Curtis, in the work already alluded to, denies their existence in many genera, yet figures the maxillary feelers. This is not reconcilable with the idea of the feelers being secondary parts, or with their name, *maxillary*. The existence of the hand presupposes the existence of the arm. The existence of the feeler presupposes the existence of the part that bears it. I refer you to the genera *Oxycera*,<sup>c</sup> *Scatophaga*, *Drapetis*, *Helcomyza*, *Sepsis*, *Tyrophaga*, *Medeterus*, &c. &c. In two of these genera, *Scatophaga* and *Helcomyza*, I find that the feeler springs from a short and nearly quadrate piece, on which it is not placed quite perpendicularly, but leans a little outwards, and to which it is joined by a very evident suture. Is not this smaller basal joint of the feeler the true feeler-jaw? The blade of the feeler-jaws varies little excepting in length. The feelers vary in many particulars: the variation in the number of their joints is worthy of notice. In the *Culicites* they are long and five-jointed, the central joint being the longest. In the *Tipulites* they are short, and have five joints, all the joints being nearly equal in length. In *Bibio*, and its congeners, nearly the same. In the *Tabanites*, *Asilites*, *Muscites*, &c., they appear to be three-jointed; the basal joint short and indistinct; the second more slender, and rather longer; the third stouter and longer than either.

In *Hymenoptera* we find a considerable change takes place in the feeler-jaws. The bees appear to be the nearest

<sup>c</sup> *Oxycera*. Maxillæ and mandibles none. Palpi short, linear, membranous and compressed; thickened, opaque and pubescent at the apex.—Curtis.

approach to *Diptera*; and on this account the examination of their mouth is not unimportant. The insertion is a small triangular piece, on which the disk and feeler-bearer are seated. Their union is usually by a distinct longitudinal suture. The feeler is slender, five or six-jointed, and situated close to the base of the blade. The blade is long, slender, flexible, and elastic; it unites with the *ligula*, and labial-feelers in forming a honey-sucking tube. In all these respects, excepting the union with the *ligula*, the feeler-jaws of the bees very closely resemble those of *Lepidoptera*. In *Nomada* the feeler and the blade are of equal length. In *Saropoda* the feeler is about one-fifth as long as the blade. In *Bombus* it is scarcely one-fifteenth the length. In *Melecta* the disk and blade are of nearly equal length: the feeler is about one-third their length. In *Andrena*, *Halictus*, *Dasy-poda*, *Colletes*, *Hylaeus*, and *Sphecodes*,<sup>d</sup> the length of the blade is much diminished. The division of the other parts is in these genera much more manifest. *Vespa*, *Odynerus*, &c. display a greater change: in these the feeler is much longer than the blade. In *Hedycrum* the feeler-bearer is longer than the insertion and stalk together: the *galea*, or helmet, also reappears in a large oval form; the blade is short; the feeler is long.<sup>e</sup> Passing through the *Fossores*, the *Pupivora*, and the *Tenthredinites*, we arrive very nearly at the mouth of *Coleoptera*. In all these the helmet of the feeler-jaw is present under some of its various modifications: it is the terminal portion, and its variations are of the greatest importance as distinguishing characters.

In *Coleoptera*, the feeler-jaws have assumed much more the appearance of the mandibles, than in any class through which we have traced them. Still it is far from certain whether they are, even in this class, employed for mastication. Kirby has excellently suggested that, under their present form, they are the holders or retainers of the food, while the mandibles are employed in masticating it. Their form and situation certainly favour this idea. Dumeril supposes they also assist in mastication.<sup>f</sup> The insertion of the feeler-jaw in this class is but

<sup>d</sup> With the exception of *S. monilicornis*, before noticed.

<sup>e</sup> The description is from the dissections of *Hedycrum* in Curtis's British Entomology.

<sup>f</sup> C'est avec les mandibules que l'insecte coupe, arrache ou retient les alimens;

little conspicuous: the disk is an important and considerable part; the feeler-bearer, usually a small lobe, something resembling a basal joint; and the blade long and large, frequently with a sharp-pointed incurved apex, and a ciliated internal margin. The maxillary feelers in this class are constant and conspicuous.<sup>g</sup> They are usually composed of four distinct joints,<sup>h</sup> and possess great freedom of motion. Geoffroy not unaptly compares the feelers to hands.<sup>i</sup> The helmet is also present; and in some of the carnivorous beetles is many-jointed, and wears completely the appearance of a true feeler.<sup>k</sup> Fabricius considered it a true feeler in the carnivorous beetles. Latreille, even in his latest work, disapproves of the general application now made of the term to the same part, however different its form.<sup>l</sup> It seems strange that one who theorises so boldly and successfully as Latreille has done, should hesitate in acknowledging the obvious identity of the part in question.<sup>m</sup> In the *Cicindelites* the feelers are long, four-jointed, and placed on a round compact feeler-bearer, which precisely resembles a fifth joint. The helmet is two-jointed, and longer than the blade, which is incurved and very sharp. In the *Carabites*, the helmet is usually shorter than the blade. In the *Dytiscites* there is no essential difference. In *Parnus*, the helmet

tandis que les mâchoires recourent, broient ou érasent la partie qui se trouve comprise entre leur efforts.—*Dumeril*.

<sup>g</sup> Les palpes paroissent destinées à palper, à tâtonner l'aliment, à le toucher en tous sens, pour reconnaître ses qualités: aussi les voit-on continuellement en action lorsque l'insecte mange. Dans beaucoup d'espèces ils servent évidemment à redresser l'aliment, afin qu'il soient mieux saisi par les mandibules, dont l'office est d'agir comme les dents incisives et lanaïres chez les mammifères.—*Dumeril*.

<sup>h</sup> There is, in all probability, a uniform number of articulations in the feelers of the insects of every class. It is worthy of remark, that every new discovery in natural history tends to harmonize phenomena previously at variance; and adds to, rather than subtracts from, the symmetry of the whole.

<sup>i</sup> Leur usage paraît être de servir comme d'espèce de mains, pour retenir les matières que mange l'insecte et qu'il tient à sa bouche.—*Geoffroy*.

<sup>k</sup> La galea prend quelquefois la forme des palpes, ce qui a fait dire que certains Coléoptères, tels que les *Cicindela*, avaient six palpes à la bouche: dans ce même genre il est formé de deux articles arrondis et fort allongés; dans d'autres il n'en a qu'un seul: il est souvent terminé par une grosse masse membraneuse, couverts de poils touffus, et quelquefois il est entièrement nu; enfin les *Cetonia* sont entièrement dépourvus.—*Straus-Dürckheim*.

<sup>l</sup> Je ne saurais approuver M. Straus qui n'ayant pas égard à ces modifications, donne au galea une acceptation trop générale.—*Latreille*.

<sup>m</sup> See Plate V., and trace the helmet ( $\ddot{o}$ ) in Hymenopterous, Coleopterous, and Orthopterous insects.

is a large, obtuse, exarticulate terminal lobe. In the *Hydrophilites*, the maxillary feelers are used as *antennæ*; they are consequently very long: the helmet is a distinct obtuse lobe. In the *Scarabæites*, the feeler-jaws are soft, membranaceous, and hairy; the helmet is extremely pilose and indistinct. In *Lucanus* the helmet is remarkable; it is employed to draw up sap into the mouth, and thus performs the office of a tongue. In the *Cerambycites*, *Curculionites*, &c. all the parts are obvious; their variations are very valuable in generic descriptions. In *Orthoptera*, the parts and appendages of the feeler-jaws are very fully developed. The helmet in this class appears to have reached its maximum; it is frequently, as in *Acridium*, three-jointed: in *Acheta*, the common cricket, it consists of two joints, the basal being the shorter. In *Hemiptera*,<sup>n</sup> the feeler-jaws undergo a complete change. Their appendages are obsolete. Their blade is a slender hair, encased in the under lip, already described;<sup>o</sup> the pair being united, serrated, and linguiform:

The MANDIBULÆ or *mandibules* constitute the fourth section of the head. They are not situated, in tetrapterous hexapods, more in front or further from the *prothorax* than the feeler-jaws; but in the apterous octopods they retain their position in front, while the feeler-jaws, with their appendages, take up their station immediately behind. The mandibles are situated above the feeler-jaws and below the upper lip, one on each side the mouth. It is worthy of remark, that the mandibles form a striking exception to the rule which assigns to an insect, longitudinally divided down the centre, two equal halves alike in all their parts. The mandibles in those classes, in which they possess the horizontal motion before alluded to, are almost invariably different in the structure of their inner surface. My attention was called to this in the first instance, by finding that

<sup>n</sup>. In first dissecting the mouth of *Hemiptera*, I had concluded, with the early entomologists, that the long lances were never more than three in number. The central filament, which I then supposed to be the tongue, is certainly, in some *Cimicites*, divisible into two *laciniae*, which I presume correspond with the *maxille* of other insects.

<sup>o</sup> Tous les auteurs ont écrit que le bec des Hemiptères contenait un sucoir formé par trois soies. Le fait n'est pas exact; le sucoir des Hemiptères se composé toujours de quatre soies, bien distinctes, c'est-à-dire, de deux mandibules et de deux mâchoires. Ces quatres pièces sont cornées, renflées à la base, comprimées et armées de cils ou de dents très aiguës, lorsque les espèces sont carnassières.—*Savigny*.

the outlines occasionally given to illustrate genera, frequently differed from my own dissections. Latreille, and several other entomologists, have been fully aware of this discrepancy, which is occasionally so great, that a figure, however accurate, of a single mandible, will by no means characterise a genus. Every description, therefore, taken from a single mandible, is faulty. I am aware this will be found a sweeping censure; but it appears to me nevertheless a sound one. The mandibles in all these classes have denticulations or teeth more or less developed on their interior margins. It is to be observed, that the mandibles are the *maxillæ* by Linnaeus.<sup>p</sup> In *Lepidoptera* the mandibles are of a substance and size corresponding with that of the upper lip.<sup>q</sup> It does not appear that they perform any office, or are possessed of any motion.<sup>r</sup> In *Diptera* the mandibles are elongate, pointed and lancet-like, and in most respects, excepting the want of feelers, resemble the feeler-jaws. They are now possessed of a decided motion, essentially different however from that of the mandibles of masticating insects. Their motion is more of a vertical jerk, by which the insect stabs them into the skin of the object which it attacks. The precise character of the motion has not, however, been satisfactorily ascertained. The variations of the mandibles in *Diptera* are chiefly in size. In *Hymenoptera* the mandibles are abbreviated, osseous, and masticatory. They now have a distinct, free, and powerful horizontal motion, and, with the feeler-jaws, close the mouth laterally. They are subject to little variation throughout the class. In *Coleoptera*, the mandibles are still more developed, forming by far the most conspicuous part of the mouth. They do not so completely

<sup>p</sup> *Lucanus scutellatus*: maxillis exsertis apice bifurcatis latera unidentatis.—*Linnaeus*.

<sup>q</sup> Les mandibules sont d'une exiguë proportionnée à celle de la lèvre supérieure. Dans la plupart des espèces elles paraissent à la loupe beaucoup moins grandes que les écailles qui couvrent le chaperon : elles sont appuyées sur les deux côtés de la trompe, et trop écartées pour pouvoir se toucher par leur sommet. Leur mouvement est assez obscur et dans certains genres, comme dans les *Sphinx* elles paroissent plutôt soudées au chaperon qu'articulées ; d'autrefois elles font corps avec la base de la lèvre supérieure : elles sont d'ailleurs cornées, très lisses dessus et dessous, vides au dedans, tantôt aplaties, tantôt renflées, plus ou moins coniques, divergentes, parallèles ou convergentes, pointues ou obtuses, suivant les genres, mais dans tous bordées de cils très-épais sur leur tranchant interieur.—*Savigny*.

<sup>r</sup> See Plate VI. figs 1, 2, 3, 4, i.

close the mouth as in *Hymenoptera*; in some instances not even uniting, except in defence.<sup>s</sup> In others, as the beautiful *Cicindelites*, the mandibles cross each other in front of the mouth. In others, the mandibles are at their edges soft and flexible. This is particularly the case with those beetles whose food is the pollen of flowers, as the *Cetoniidæ*.<sup>t</sup> Another family, *Aphodiidæ*,<sup>u</sup> whose food is the recent excrement of cattle, has a similar peculiarity. In *Orthoptera*, particularly the locust tribes, the mandibles are osseous, large, and powerful. Marcel de Serres discovers, as he imagines, an analogy between the teeth which arm the mandibles of *Orthoptera*, and those possessed by the mammiferous animals. He accordingly names them *incisive*, *canine* and *molar*. Your readers will be pleased by a reference to his paper.<sup>x</sup> Though speculative in ideas, it is rigidly accurate in facts. I am not disposed to apply to annulose animals the anatomical terms employed for the vertebrates, unless their propriety be at once manifest.<sup>y</sup> In the present instance, moreover, the nomenclature of these parts is not applicable to generic or other characters, and therefore comes not within the compass of this essay. In *Hemiptera*, they undergo a complete alteration; and here, as in *Diptera*, they are elongate, pointed, flexible, lancet-like, and without the horizontal motion.

LINGUA, or tongue. The tongue of insects is an organ but little known. This arises, in some measure, from its being generally inconspicuous: and partly from the application of the names *Ligula*, *Lingua*,<sup>'</sup> *Languette*, *Langue*, *Tongue*, &c. to a part, which

<sup>'</sup> In *Lucanus*, the great Stag Beetle, more particularly; this insect also employs his immense mandibles to pierce the tender bark of young trees. He applies his *antennæ* to the wound he has made, and if he finds that the sap flows, he inserts the helmets of his feeler-jaws in the wound. He sucks up the sap as it flows.

<sup>t</sup> *Mandibulæ compressæ*, *tenues*, *lanceolatæ*, *membrana subquadrata intus auctæ*, *hujus latere externo producto et basi vix cornicis vel corneis*.—*MacLeay*.

<sup>u</sup> *Mandibulæ clypeo obtutæ*, *ad basin corneæ*, *deinde in laminam brevem, compressam, dilatatam, coriaceam aut vix membranaceam productæ*.—*MacLeay*.

<sup>x</sup> *Annales du Muséum*, No. XIV. p. 56. *Les dents des ulonates peuvent se diviser comme celle des quadrupédés en incisives, en laciaires ou canines, et en molaires*.—*Marcel de Serres*.

<sup>y</sup> Such terms as *nose*, *ears*, and *hands* have been applied to beetles; do they not tend rather to excite a smile, than convey a scientific idea? I do not mention this out of disrespect to the authors of such names, but to shew how very widely fancy may lead us, if we determine on *providing* analogies.

is in reality nothing more than the limb, or elongate process of the under lip. The true tongue is the *hypopharynx* or *lingua* of Savigny. I cannot find it mentioned by Fabricius, except as a *seta* in the mouth of *Diptera*. Cuvier first notices it as a tongue in *Orthoptera*. Savigny clearly points it out in *Diptera*, *Hymenoptera*, *Orthoptera* and *Hemiptera*. Our illustrious countryman, Kirby, applies the term *lingua* to the right part in *Orthoptera*, *Hemiptera*, and *Neuroptera*: but in *Hymenoptera* and *Coleoptera*, he has given this name to the process of the lower lip, already described as the *ligula*. In *Diptera* he has declined naming it.<sup>a</sup> Latreille, in his earlier works, calls this part by various names; but in his *Cours d'Entomologie*, he clearly points out the true tongue, and laudably proposes that the last name should be restricted to it. My ideas on the subject have somewhat altered since I gave a cursory sketch of the mouth on a former occasion. I am happy in being able thus to point out my own error before the unthankful task has devolved on another. Beautifully has De Geer observed, that the evil is not very great, if further observation prove our old ideas to be untenable; we have then merely to remodel those ideas by the result of the later observation.<sup>a</sup> It ever has been, and may it still continue to be, my endeavour to amend an error as soon as I am aware of it. In *Lepidoptera* the tongue has never yet been noticed. Latreille fancied, if I comprehend him rightly, that it existed in the suture, uniting the feeler-jaws.<sup>b</sup> I have observed, very near the pharynx, but a little below it in *Sphinx Ligustri*, a small mammiform protuberance. This is so exactly the site of the tongue in bees, that it seems wonderful that the accurate Savigny should have overlooked it. I can

<sup>a</sup> See Plate VII. fig. 5, in the Introduction to Entomology.

<sup>b</sup> Le mal n'est pas même fort grand si par des nouvelles observations on trouve s'être trompé dans ses idées; il n'y a lorsqu'à les changer selon le résultat de ces observations ultérieurs.—*De Geer*.

<sup>b</sup> Amongst these parts (of the mouth in *Lepidoptera*), there seems at first sight no representative of the tongue; but M. Latreille has advanced some very ingenious, and, I think, satisfactory arguments, which go to prove that this part, at least the tongue, in *Hymenoptera*, has its analogue in the intermediate tube or *fistula* formed by the union of the two *maxillæ*, and which conveys the fluid aliment of this order to the *pharynx*. As in *Diptera* the *maxillæ* sometimes merge in the *labium*, so here the tongue (as it were, divided longitudinally) merges in the *maxillæ*.—*Kirby*.

have no doubt that this is the true tongue. In *Diptera* it is elongate and sharp-pointed, and is the part so named in Curtis's figures of *Anopheles* and *Tabanus*. In *Hymenoptera* it is shorter, but still evident, particularly in the bees, as *Eucera*, &c. In *Coleoptera*, it is still less prominent, and assimilates to its Lepidopterous form already described. In *Orthoptera* it increases in size, and in the common cock-roach very nearly approaches the shape, appearance, and relative size of the human tongue. In *Locusta* it is very large. In *Hemiptera* the tongue is the central and generally the shortest organ of the mouth: it has not, however, escaped the lynx-eyed researches of Savigny and Leon-Dufour.

The next letter relates to the segments which bear the organs of locomotion.

I am, &c.

EDWARD NEWMAN.

Deptford, March 1, 1833.

*By the same Author, price 4s.*

## Sphinx Vespiiformis;

### AN ESSAY.

FREDERICK WESTLEY and A. H. DAVIS, 10, Stationers'-Hall-Court.

---

"We recommend 'Sphinx Vespiiformis' as a sensible and well written Essay, deserving the attention of Naturalists."—*New Monthly*.

"We cordially recommend 'Sphinx Vespiiformis' as necessary to the library of every entomologist."—*Mag. Nat. Hist.*

"Allow me to point out how slightly Mr. NEWMAN's general arrangement really differs from that adopted in my 'Systematic Catalogue.'"—*J. F. Stephens in Mag. Nat. Hist.*

"A perusal (of 'Sphinx Vespiiformis') will amply repay the reader for the requisite time and attention."—*Entom. Mag.*

"I consider the system proposed in 'Sphinx Vespiiformis' to be the system of nature."—*Scrutator in Entom. Mag.*

"The idea which Mr. NEWMAN has stated, of the superiority of one of the divisions of a natural group, and of its central situation, is a very happy one, and deserves much consideration."—*J. O. Westwood, in Entom. Mag.*

"Here is enough to make us consider a little before we reject a system which is in harmony with so many natural affinities."—*E. Doubleday in Entom. Mag.*

